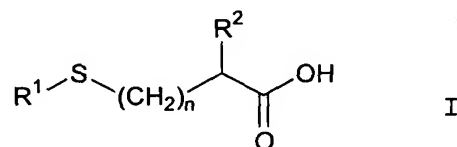


WHAT IS CLAIMED IS:

Claims

1. A composition comprising a compound of Formula I and one or more other organic acids, wherein said compound of Formula I has the following structure:



5 wherein R¹ is an alkyl group having from one to four carbon atoms;

 n is an integer from 0 to 2;

 R² is selected from the group consisting of hydroxy, amino, -OCOR³, or -NHCOR³; and

10 R³ is an organic acid derivative;

 or a salt thereof;

 and an acceptable diluent, adjuvant or excipient.

2. The composition of claim 1 wherein said organic acid derivative is derived from an organic acid having at least one carboxyl moiety and having a pK_a of less than about 5.5.

3. The composition of claim 2 wherein said organic acid derivative is derived from an organic acid selected from the group consisting of formic acid, acetic acid, propionic acid, butyric acid, benzoic acid, lactic acid, malic acid, tartaric acid, mandelic acid, citric acid, fumaric acid, sorbic acid, boric acid, succinic acid, adipic acid, glycolic acid, and glutaric acid, or mixtures thereof.

4. The composition of claim 3 wherein said other organic acid is an organic acid having at least one carboxyl moiety and having a pK_a of less than about 5.5.

5. The composition of claim 4 wherein said other organic acid is selected from the group consisting of formic acid, acetic acid, propionic acid, butyric acid, benzoic acid, lactic acid, malic acid, tartaric acid, mandelic acid, citric acid, fumaric acid, sorbic acid, boric acid, succinic acid, adipic acid, glycolic acid, and glutaric acid, or mixtures thereof.

6. The composition of claim 5 wherein said compound of Formula I is 2-hydroxy-4-(methylthio)butanoic acid, or a salt, ester or amide thereof.

7. The composition of claim 6 wherein said other organic acid is selected from the group consisting of formic acid, acetic acid, propionic acid, butyric acid, lactic acid, citric acid, and fumaric acid.

8. The composition of claim 7 wherein the combined concentration of said compound of Formula I and said other organic acid in said composition is between about 0.1 g/kg and about 50 g/kg.

9. The composition of claim 8 wherein said combined concentration is between about 0.8 g/kg and about 30 g/kg.

10. The composition of claim 8 wherein said combined concentration is between about 1 g/kg and about 25 g/kg.

11. The composition of claim 8 wherein said combined concentration is between about 1 g/kg and about 10 g/kg.

12. The composition of claim 1 comprising 2-hydroxy-4-(methylthio)butanoic acid, or a salt, ester or amide thereof; and a first organic acid selected from the group consisting of formic acid, acetic acid, propionic acid, butyric acid, benzoic acid, lactic acid, malic acid,

tartaric acid, mandelic acid, citric acid, fumaric acid, sorbic acid, boric acid, succinic acid, adipic acid, glycolic acid, and glutaric acid.

13. The composition of claim 12 wherein said first organic acid is selected from the group consisting of formic acid, propionic acid, butyric acid, and lactic acid.

14. The composition of claim 12 further comprising an acidulant selected from the group consisting of mineral acids.

15. The composition of claim 14 wherein said acidulant is selected from the group consisting of phosphoric acid, sulfuric acid, phosphorous acid, hydrochloric acid, hydrobromic acid, and nitric acid.

16. The composition of claim 15 further comprising a second organic acid selected from the group consisting of formic acid, acetic acid, propionic acid, butyric acid, benzoic acid, lactic acid, malic acid, tartaric acid, mandelic acid, citric acid, fumaric acid, sorbic acid, boric acid, succinic acid, adipic acid, glycolic acid, and glutaric acid.

17. The composition of claim 16 wherein said first organic acid and second organic acid are independently selected from the group consisting of formic acid, propionic acid, butyric acid, and lactic acid.

18. The composition of claim 17 wherein said first organic acid is formic acid, said second organic acid is propionic acid, and said acidulant is phosphoric acid.

19. The composition of claim 18 wherein the content of 2-hydroxy-4-(methylthio)butanoic acid is from about 5% to about 20% of the sum of the 2-hydroxy-4-

(methylthio)butanoic acid, formic acid, propionic acid, and phosphoric acid content;

the content of the formic acid is from about 65% to about 85% of said sum;

5 the content of the propionic acid is from about 1% to about 15% of said sum; and

the content of the phosphoric acid is from about 5% to about 20% of said sum.

10 20. The composition of claim 19 wherein the content of 2-hydroxy-4-(methylthio)butanoic acid is about 10% of said sum;

the content of the formic acid is about 75% of said sum;

15 the content of the propionic acid is about 5% of said sum; and

the content of the phosphoric acid is about 10% of said sum.

20 21. The composition of claim 18 wherein the content of 2-hydroxy-4-(methylthio)butanoic acid is from about 20% to about 40% of the sum of the 2-hydroxy-4-(methylthio)butanoic acid, formic acid, propionic acid, and phosphoric acid content;

the content of the formic acid is from about 45% to about 65% of said sum;

25 the content of the propionic acid is from about 1% to about 20% of said sum; and

the content of the phosphoric acid is from about 1% to about 15% of said sum.

30 22. The composition of claim 21 wherein the content of 2-hydroxy-4-(methylthio)butanoic acid is about 30% of said sum;

the content of the formic acid is about 55% of said sum;

the content of the propionic acid is about 10% of said sum; and

the content of the phosphoric acid is about 5% of said sum.

5 23. The composition of claim 17 wherein said first organic acid is butyric acid, said second organic acid is lactic acid, and said acidulant is phosphoric acid.

10 24. The composition of claim 23 wherein the content of 2-hydroxy-4-(methylthio)butanoic acid is from about 20% to about 40% of the sum of the 2-hydroxy-4-(methylthio)butanoic acid, butyric acid, lactic acid, and phosphoric acid content;

the content of the butyric acid is from about 10% to about 30% of said sum;

15 the content of the lactic acid is from about 10% to about 30% of said sum; and

the content of the phosphoric acid is from about 20% to about 40% of said sum.

20 25. The composition of claim 24 wherein the content of 2-hydroxy-4-(methylthio)butanoic acid is about 30% of said sum;

the content of the butyric acid is about 20% of said sum;

25 the content of the lactic acid is about 20% of said sum; and

the content of the phosphoric acid is about 30% of said sum.

30 26. The composition of claim 23 wherein the content of 2-hydroxy-4-(methylthio)butanoic acid is from about 20% to about 40% of the sum of the 2-hydroxy-4-(methylthio)butanoic acid, butyric acid, lactic acid, and phosphoric acid content;

the content of the butyric acid is from about 5% to about 25% of said sum;

the content of the lactic acid is from about 10% to about 30% of said sum; and

5 the content of the phosphoric acid is from about 25% to about 45% of said sum.

27. The composition of claim 26 wherein the content of 2-hydroxy-4-(methylthio)butanoic acid is about 30% of said sum;

10 the content of the butyric acid is about 15% of said sum;

the content of the lactic acid is about 20% of said sum; and

15 the content of the phosphoric acid is about 35% of said sum.

28. The composition of claim 16 further comprising a third organic acid selected from the group consisting of formic acid, acetic acid, propionic acid, butyric acid, benzoic acid, lactic acid, malic acid, tartaric acid, 20 mandelic acid, citric acid, fumaric acid, sorbic acid, boric acid, succinic acid, adipic acid, glycolic acid, and glutaric acid.

29. The composition of claim 28 wherein said first organic acid is butyric acid, said second organic acid is 25 formic acid, said third organic acid is lactic acid, and said acidulant is phosphoric acid.

30. The composition of claim 29 wherein the content of 2-hydroxy-4-(methylthio)butanoic acid is from about 10% to about 30% of the sum of the 2-hydroxy-4-(methylthio)butanoic acid, butyric acid, formic acid, 30 lactic acid, and phosphoric acid content;

the content of the butyric acid is from about 2% to about 22% of said sum;

the content of the formic acid is from about 20% to about 40% of said sum;

the content of the lactic acid is from about 8% to about 28% of said sum; and

5 the content of the phosphoric acid is from about 10% to about 30% of said sum.

31. The composition of claim 30 wherein the content of 2-hydroxy-4-(methylthio)butanoic acid is about 20% of said sum;

10 the content of the butyric acid is about 12% of said sum;

the content of the formic acid is about 30% of said sum;

15 the content of the lactic acid is about 18% of said sum; and

the content of the phosphoric acid is about 20% of said sum.

32. The composition of claim 28 wherein said first organic acid is butyric acid, said second organic acid is lactic acid, said third organic acid is propionic acid, and said acidulant is phosphoric acid.

33. The composition of claim 32 wherein the content of 2-hydroxy-4-(methylthio)butanoic acid is from about 10% to about 30% of the sum of the 2-hydroxy-4-(methylthio)butanoic acid, butyric acid, lactic acid, propionic acid, and phosphoric acid content;

the content of the butyric acid is from about 2% to about 22% of said sum;

30 the content of the lactic acid is from about 8% to about 28% of said sum;

the content of the propionic acid is from about 20% to about 40% of said sum; and

the content of the phosphoric acid is from about 10% to about 30% of said sum.

34. The composition of claim 33 wherein the content of 2-hydroxy-4-(methylthio)butanoic acid is about 20% of said sum;

the content of the butyric acid is about 12% of said sum;

the content of the lactic acid is about 18% of said sum;

the content of the propionic acid is about 30% of said sum; and

the content of the phosphoric acid is about 20% of said sum.

35. The composition of claim 28 wherein said first organic acid is butyric acid, said second organic acid is formic acid, said third organic acid is propionic acid, and said acidulant is phosphoric acid.

36. The composition of claim 35 wherein the content of 2-hydroxy-4-(methylthio)butanoic acid is from about 1% to about 20% of the sum of the 2-hydroxy-4-(methylthio)butanoic acid, butyric acid, formic acid, propionic acid, and phosphoric acid content;

the content of the butyric acid is from about 1% to about 15% of said sum;

the content of the formic acid is from about 65% to about 85% of said sum;

the content of the propionic acid is from about 1% to about 15% of said sum; and

the content of the phosphoric acid is from about 1% to about 15% of said sum.

37. The composition of claim 36 wherein the content of 2-hydroxy-4-(methylthio)butanoic acid is about 10% of said sum;

the content of the butyric acid is about 5% of said sum;

the content of the formic acid is about 75% of said sum;

the content of the propionic acid is about 5% of said sum; and

5 the content of the phosphoric acid is about 5% of said sum.

38. The composition of claim 12 further comprising a second organic acid, wherein said first organic acid and said second organic acid are independently selected from the group consisting of formic acid, propionic acid, butyric acid, and lactic acid.

39. The composition of claim 38 wherein said first organic acid is formic acid and said second organic acid is propionic acid.

40. The composition of claim 39 wherein the content of 2-hydroxy-4-(methylthio)butanoic acid is from about 20% to about 40% of the sum of the 2-hydroxy-4-(methylthio)butanoic acid, formic acid, and propionic acid content;

20 the content of the formic acid is from about 40% to about 60% of said sum; and

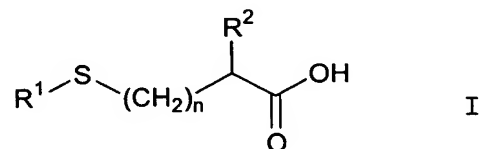
the content of the propionic acid is from about 10% to about 30% of said sum.

41. The composition of claim 40 wherein the content of 2-hydroxy-4-(methylthio)butanoic acid is about 30% of said sum;

the content of the formic acid is about 50% of said sum; and

30 the content of the propionic acid is about 20% of said sum.

42. A composition comprising a compound of Formula I and an acidulant, wherein said compound of Formula I has the following structure:



wherein R¹ is an alkyl group having from one to four carbon atoms;

n is an integer from 0 to 2;

R² is selected from the group consisting of hydroxy, amino, -OCOR³, or -NHCOR³; and

R³ is an organic acid derivative;

or a salt thereof;

and an acceptable diluent, adjuvant or excipient;

wherein said acidulant is selected from the group consisting of mineral acids.

43. The composition of claim 42 wherein said organic acid derivative is derived from an organic acid selected from the group consisting of formic acid, acetic acid, propionic acid, butyric acid, benzoic acid, lactic acid, malic acid, tartaric acid, mandelic acid, citric acid, fumaric acid, sorbic acid, boric acid, succinic acid, adipic acid, glycolic acid, and glutaric acid, or mixtures thereof.

44. The composition of claim 43 wherein said acidulant is selected from the group consisting of phosphoric acid, sulfuric acid, phosphorous acid, hydrochloric acid, hydrobromic acid, and nitric acid.

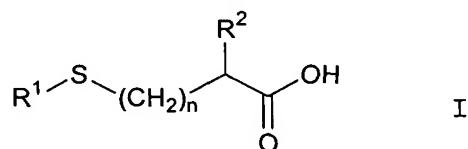
45. The composition of claim 44 wherein the content of the 2-hydroxy-4-(methylthio)butanoic acid is from about 5% to about 50% of the sum of the 2-hydroxy-4-(methylthio)butanoic acid and acidulant content.

46. The composition of claim 45 wherein the content of the 2-hydroxy-4-(methylthio)butanoic acid is about 5% of said sum.

47. The composition of claim 45 wherein the content of the 2-hydroxy-4-(methylthio)butanoic acid is about 25% of said sum.

48. The composition of claim 45 wherein the content of the 2-hydroxy-4-(methylthio)butanoic acid is about 45% of said sum.

49. A combination comprising a compound of Formula I and one or more other organic acids, wherein said compound of Formula I has the following structure:



wherein R¹ is an alkyl group having from one to four carbon atoms;

n is an integer from 0 to 2;

R² is selected from the group consisting of hydroxy, amino, -OCOR³, or -NHCOR³; and

R³ is an organic acid derivative;

or a salt thereof;

and an acceptable diluent, adjuvant or excipient.

50. The combination of claim 49 wherein said organic acid derivative is derived from an organic acid having at least one carboxyl moiety and having a pK_a of less than about 5.5.

51. The combination of claim 50 wherein said organic acid derivative is derived from an organic acid selected from the group consisting of formic acid, acetic acid, propionic acid, butyric acid, benzoic acid, lactic acid,

malic acid, tartaric acid, mandelic acid, citric acid, fumaric acid, sorbic acid, boric acid, succinic acid, adipic acid, glycolic acid, and glutaric acid, or combinations thereof.

5 52. The combination of claim 51 wherein said other organic acid is an organic acid having at least one carboxyl moiety and having a pK_a of less than about 5.5.

10 53. The combination of claim 52 wherein said other organic acid is selected from the group consisting of formic acid, acetic acid, propionic acid, butyric acid, benzoic acid, lactic acid, malic acid, tartaric acid, mandelic acid, citric acid, fumaric acid, sorbic acid, boric acid, succinic acid, adipic acid, glycolic acid, and glutaric acid, or combinations thereof.

15 54. The combination of claim 53 wherein said compound of Formula I is 2-hydroxy-4-(methylthio)butanoic acid, or a salt, ester or amide thereof.

20 55. The combination of claim 49 comprising 2-hydroxy-4-(methylthio)butanoic acid, or a salt, ester or amide thereof; and a first organic acid selected from the group consisting of formic acid, propionic acid, butyric acid, and lactic acid.

25 56. The combination of claim 55 further comprising an acidulant selected from the group consisting of phosphoric acid, sulfuric acid, phosphorous acid, hydrochloric acid, hydrobromic acid, and nitric acid.

30 57. The combination of claim 56 further comprising a second organic acid selected from the group consisting of formic acid, propionic acid, butyric acid, and lactic acid.

58. The combination of claim 57 wherein said first organic acid is formic acid, said second organic acid is propionic acid, and said acidulant is phosphoric acid.

5 59. The combination of claim 57 wherein said first organic acid is butyric acid, said second organic acid is lactic acid, and said acidulant is phosphoric acid.

60. The combination of claim 57 further comprising a third organic acid selected from the group consisting of formic acid, propionic acid, butyric acid, and lactic acid.

10 61. The combination of claim 60 wherein said first organic acid is butyric acid, said second organic acid is formic acid, said third organic acid is lactic acid, and said acidulant is phosphoric acid.

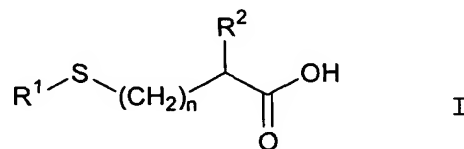
15 62. The combination of claim 60 wherein said first organic acid is butyric acid, said second organic acid is lactic acid, said third organic acid is propionic acid, and said acidulant is phosphoric acid.

20 63. The combination of claim 60 wherein said first organic acid is butyric acid, said second organic acid is formic acid, said third organic acid is propionic acid, and said acidulant is phosphoric acid.

64. The combination of claim 55 further comprising a second organic acid selected from the group consisting of formic acid, propionic acid, butyric acid, and lactic acid.

25 65. The combination of claim 64 wherein said first organic acid is formic acid and said second organic acid is propionic acid.

66. A combination comprising a compound of Formula I and an acidulant, wherein said compound of Formula I has the following structure:



wherein R¹ is an alkyl group having from one to four carbon atoms;

n is an integer from 0 to 2;

R² is selected from the group consisting of hydroxy, amino, -OCOR³, or -NHCOR³; and

R³ is an organic acid derivative;

or a salt thereof;

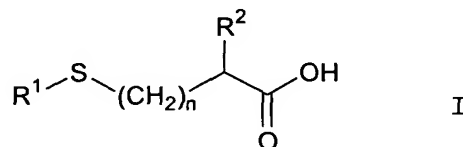
and an acceptable diluent, adjuvant or excipient;

wherein said acidulant is selected from the group consisting of phosphoric acid, sulfuric acid, phosphorous acid, hydrochloric acid, hydrobromic acid, and nitric acid.

67. The combination of claim 66 wherein said organic acid derivative is derived from an organic acid selected from the group consisting of formic acid, propionic acid, butyric acid, and lactic acid.

68. The combination of claim 67 wherein the content of the compound of Formula I is from about 5% to about 50% of the sum of the compound of Formula I and acidulant content.

69. An animal feed composition comprising a compound of Formula I and one or more other organic acids, wherein said compound of Formula I has the following structure:



wherein R¹ is an alkyl group having from one to four carbon atoms;

n is an integer from 0 to 2;

R² is selected from the group consisting of hydroxy, amino, -OCOR³, or -NHCOR³; and

R³ is an organic acid derivative;

5 or a salt thereof;

and an acceptable diluent, adjuvant or excipient.

70. The composition of claim 69 comprising

2-hydroxy-4-(methylthio)butanoic acid, or a salt, ester or amide thereof; and

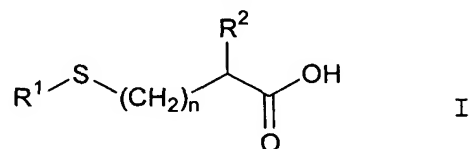
10 a first organic acid selected from the group consisting of formic acid, propionic acid, butyric acid, and lactic acid.

71. The composition of claim 70 further comprising an acidulant selected from the group consisting of phosphoric
15 acid, sulfuric acid, phosphorous acid, hydrochloric acid, hydrobromic acid, and nitric acid.

72. The composition of claim 71 further comprising a second organic acid selected from the group consisting of formic acid, propionic acid, butyric acid, and lactic acid.

20 73. The composition of claim 70 further comprising a second organic acid selected from the group consisting of formic acid, propionic acid, butyric acid, and lactic acid.

25 74. An animal feed composition comprising a compound of Formula I and an acidulant, wherein said compound of Formula I has the following structure:



wherein R¹ is an alkyl group having from one to four carbon atoms;

n is an integer from 0 to 2;

R² is selected from the group consisting of hydroxy, amino, -OCOR³, or -NHCOR³; and

R³ is an organic acid derivative;
or a salt thereof;

5 and an acceptable diluent, adjuvant or excipient;
 wherein said acidulant is selected from the group
consisting of phosphoric acid, sulfuric acid, phosphorous
acid, hydrochloric acid, hydrobromic acid, and nitric acid.

10 75. A method of inhibiting or killing microbes in a
subject, comprising treating said subject with a
composition according to claim 1.

76. The method of claim 75 wherein said subject is
water or food.

15 77. The method of claim 76 wherein said food is
selected from the group consisting of human food, livestock
food, pet food, or aquaculture food.

78. The method of claim 77 wherein said composition is
mixed with the food as it is formulated.

20 79. The method of claim 78 wherein said composition is
applied to a pre-mixed or pre-pelleted feed.

80. The method of claim 79 wherein said composition,
subsequent to treating said food, is uniformly dispersed
throughout said food.

25 81. The method of claim 76 wherein said food comprises
a meat or bone meal.

82. The method of claim 76 wherein said food is dry
food.

83. The method of claim 76 wherein said food is liquid food.

84. The method of claim 76 wherein said food is a combination of dry feed and liquid food.

5 85. The method of claim 76 wherein said food is fed to an animal.

86. The method of claim 85 wherein said animal is a ruminant animal.

10 87. The method of claim 86 wherein said ruminant animal is selected from the group consisting of dairy cows, lactating dairy cows, dairy calves, beef cattle, sheep, and goats.

88. The method of claim 85 wherein said animal is an aquaculture.

15 89. The method of claim 88 wherein said aquaculture is fish or crustaceans.

90. The method of claim 85 wherein said animal is livestock.

20 91. The method of claim 90 wherein said livestock is swine or horses.

92. The method of claim 85 wherein said animal is poultry.

25 93. The method of claim 92 wherein said poultry is selected from the group consisting of chickens, turkeys, and hatchlings thereof.

94. The method of claim 85 wherein said animal is a companion animal.

95. The method of claim 94 wherein said companion animal is a dog or a cat.

5 96. The method of claim 75 wherein said microbe is a bacterium.

97. The method of claim 75 wherein said microbe is a mold.

10 98. A method of killing mold in food or water comprising corn and soy, the method comprising applying to said food or water a composition according to claim 1.

99. A method of killing mold in food having a moisture content of from 0-17%, the method comprising applying to said food a composition according to claim 1.

15 100. The method of claim 99 wherein said moisture content is at least 0.01% by weight of the food.

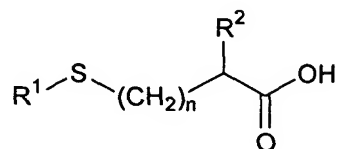
101. The method of claim 99 wherein said moisture content is at least 1% by weight of the food.

20 102. The method of claim 99 wherein said moisture content is at least 5% by weight of the food.

103. The method of claim 99 wherein said moisture content is at least 10% by weight of the food.

25 104. The method of claim 75 wherein said animal food is heat-treated, either before or after application of said composition.

105. A method for enhancing the palatability of animal food, the method comprising treating the food with a compound of Formula I:



wherein R¹ is an alkyl group having from one to four carbon atoms;

n is an integer from 0 to 2;

R² is selected from the group consisting of hydroxy, amino, -OCOR³, or -NHCOR³;

and wherein R³ is an organic acid derivative;

or a salt thereof.

wherein the concentration of the compound of Formula I in the food is between about 0.01 wt.% and about 0.5 wt.%.

106. The method of claim 105 wherein said compound of Formula I is 2-hydroxy-4-(methylthio)butanoic acid or d,l-methionine, or a salt, ester or amide thereof.

107. The method of claim 106 wherein said concentration is between about 0.05 wt.% and about 0.3 wt.%.

108. The method of claim 107 wherein said food is canine, feline, or aquaculture food.

109. The method of claim 108 wherein said food is canine food and said concentration is about 0.10 wt.%.

110. The method of claim 108 wherein said food is feline food and said concentration is about 0.25 wt.%.

111. The composition of claim 72 further comprising a third organic acid selected from the group consisting of formic acid, propionic acid, butyric acid, and lactic acid.

112. The composition of claim 73 further comprising a second organic acid selected from the group consisting of formic acid, propionic acid, butyric acid, and lactic acid.